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Peasants and plantations in the Sri Lankan tea sector: causes of the change in their relative viability*

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In contrast to the increasing trend in farm size found in most agricultural sectors, the absolute number of producers and relative share of total production from small farms growing green leaf tea in Sri Lanka have increased significantly over time. The boom in peasant production and the corresponding decline in plantations are due to the same general drivers explaining the increase in farm size elsewhere. Government programs and price effects that reduced revenue uncertainty and relative costs of production have enhanced the competitive position of small farmers relative to large estates.

Key words: farm size distribution, farm structure, peasants, plantations, Sri Lanka, tea industry.

1. Introduction

Although there has been a significant decrease in the number of farms along with a sharp rise in average farm size in most developed countries, the opposite is occurring in developing countries (Lipton 2005) particularly for sectors that were previously dominated by plantation farms (Hayami 2002; Eastwood *et al*. 2006). For example in Sri Lanka, the absolute number of small farms and the area of green leaf tea grown by these farmers have risen by 368 per cent and 296 per cent, respectively, over the last half century. In contrast, the number of tea farms larger than 100 acres declined by 57 per cent and their acreage by 36 per cent over the same period (Table 1).

The structural changes promoting small holders is desired by governments for equity reasons and land redistribution policies have been used as a means to enforce this change (Deininger and Binswanger 1999; Collier 2002; Roumasset 2004; Lipton 2005). However, other factors have also influenced the movement away from plantations to small holdings. Despite the interest in supporting small farmers, empirical analysis of the reasons behind structural changes in plantation crops have received scant attention in the literature (exceptions are Hayami 2002; Daviron 2002). Sociologists, political scientists, and historians

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Table 1 The number and area planted by small and large green leaf tea farms in Sri Lanka: 1951, 1978, and 2005

	Number of tea farms		Area planted by tea farms	
Year	Small (< 10 acres)	Large (> 100 acres)	Small (< 10 acres)	Large (> 100 acres)
1951	84 363	939	67 414	456 746
1978	129 052	782	123 528	383 082
2005	394 892	404†	267 253	293 935
Percentage change (1951–2005)	368	–57	296	–36

Notes: † The number is not for 2005 but for 1994/1995 which is the latest information available on number of plantation units from the *Plantation Sector Statistical Pocket Book* (Sri Lankan Ministry of Plantation Industries 2005).
Sources: 1951 from Snodgrass, table A 38; 1978 from Report of the committee appointed to study the constraints and problems of the tea small-holding sector, table IV (Sri Lankan Ministry Of Plan Implementation 1980); 2005 from Tea Land Survey by the Department of Census and Statistics and Tea Smallholding Development Authority.

have described the rise of plantations as a production organisation at the time of European colonial expansion (Beckford 1972; Courtney 1980; De Silva 1982; Bieber 1997) but little economic analysis exists to understand the reasons for the subsequent shift (Barlow 1997).

The purpose of this paper is to explore the drivers of the changes in the relative production of plantations versus small farms in the Sri Lankan tea sector from 1960 to 2003. In achieving this objective, the paper makes several contributions. First, potential drivers for the changes in farm size distribution are hypothesised and then empirically tested in contrast to previous studies that have explained the reasons for the initial establishment of plantations or just described the changes in organisational structure (i.e., Rote 1986). Second, the paper identifies the effectiveness of mechanisms that governments can use to meet a common objective of increasing the number of small farms from plantations. Third, the analysis provides a general test of the robustness of theories used to explain the changes in farm size but for which the empirical analysis has been limited to agricultural sectors in developed countries with increasing farm size. The results of the analysis show the importance of relative prices in determining the viability of peasants versus plantations but also highlight the importance of policy in reducing transaction costs facing the small producer. The paper begins with a discussion on the drivers of farm size changes. Section 3 introduces the empirical variables on these factors for the Sri Lankan tea sector. The econometric specification and results are then presented followed by concluding remarks.

2. Potential drivers of farm size changes

Several studies have reviewed the general drivers of changes in farm size (Chavas 2001; Eastwood *et al*. 2006). There are three major factors (technology,

prices, and government programs) and the following section describes how each driver may conceptually influence the distribution of farm size.

2.1 Technology

Technical change that is not scale-neutral may influence farm size distribution. If economies of size are embodied within the technological advances, relative average costs will be lowered for larger farms and smaller farms will be pressured to increase their size (Chavas 2001). In addition, the rate of technological adoption is often positively associated with firm size, which reinforces the competitive advantage of larger farms. According to the treadmill model of Cochrane (1979), early adopters achieve lower unit costs and hence expand output. The relatively higher unit costs faced by non-adopters, combined with lower output prices from the increased supply, forces laggards to adopt the new cost-saving technology or exit the industry. The process results in fewer and larger farms. However, Kislev and Peterson (1996) argue the evidence for technological sources of scale economies in farming is weak as a rental market for larger, lumpy inputs neutralises the competitive advantage of larger farms. Similarly, the review by Hallam (1991) of empirical studies for developed agriculture found a predominance of L-shaped long-run average cost curves implying no significant economies of size. The field production of tea in Sri Lanka also conforms to constant returns to scale, meaning that there is no technology-driven comparative advantage for larger farms (Roberts 1989; Mendis 1992).

2.2 Price effects

The substitution of capital for labour, and thus an increase in firm size and/or intensification, can be prompted by new technology but also through the relative prices for these inputs. For instance, most of the change in average US farm size has coincided with changes in the ratio of the opportunity cost of farm labour to the cost of machinery (Kislev and Peterson 1996; Huffman and Evenson 2001). Relative input prices can also influence farm structure indirectly through their impact on research activity. Hayami and Ruttan (1985) found that the biases in technical change across countries were a function of relative input prices.

Changing output prices can also affect farm size distribution. Fafchamps (1992) demonstrated that the price responses of small farms and large farms in developing countries differed by type of crop as did the rate of entry and exit. Tweeten (1984) found US farm numbers declined at a faster rate during periods of favourable prices as the higher returns become capitalised into the costs of farming assets thereby creating a barrier to entry for smaller farms. The additional funds from higher prices could also have provided more collateral for investing resulting in farm consolidation. In contrast, von Massow *et al*. (1992) found higher hog prices slowed the exodus of smaller farms. Such an inverse relationship between relative returns and average farm size may result if small farms are more responsive to relative output prices. The sunk

costs associated with asset-specific investments that cannot be allocated to other uses within the firm are more likely to be experienced by large farms, which are thus less likely than smaller ones to exit the industry during periods of depressed relative output prices.

In addition to relative prices, the volatility of output prices can influence farm structure. Operators of large farms may be less averse to risk and less likely to incur costs to avoid uncertainty (Dehn *et al*. 2005). Large farms may also have more access to information on risk management tools, such as alternative marketing strategies, and be able to utilise the information than small farms (Tweeten 1984). The increase in overhead costs of such information systems is often easier to bear if the expenses can be spread over a large volume of outputs. In addition, large farms have better access to short-term credit or overdraft facilities in cash-flow crises, particularly in developing countries (Diagne *et al*. 2000). On the other hand, small farmers are more able to diversify to stabilise average income than larger farms, which tend to specialise. Small farmers are also more able to engage in self-insurance activities, such as off-farm employment, which can buffer income fluctuations.

2.3 Government programs

Many government policies are aimed directly at influencing farm structure, whereas others affect size distribution. For example, income-support programs are designed to help marginal farmers remain in business (Eastwood *et al*. 2006). Programs with payment limitations generally will favour smaller farms but income support without such restrictions can encourage farm enlargement. Large farms may also be unintended beneficiaries of support programs if the benefits are capitalised into asset prices, as is generally the case (Weersink *et al*. 1999). Higher investment costs may prohibit entry or expansion by small farmers with lower borrowing capacity. Although direct aid from government has typically been meant to aid smaller producers, there are a number of cases where support has been provided to help farmers' transition out of the sector, thereby increasing farm size.

Investment in agriculture has been encouraged by some governments through deductions such as tax credits or rapid depreciation allowance. The value of these incentives tends to increase with firm size, so the net effect has been to speed the growth in farm size. Although tax policy has been used to encourage investment within developed countries, many developing countries tax agricultural commodities that are exported as a means to raise revenue (Khan 2001). The extent to which such an export tax is borne by primary producers depends on the relative elasticity of demand and supply. The more elastic the demand and inelastic the supply, the greater the decline in price received by the farmer.

Limited access to credit is a market failure that has been used to justify the actions of government to ensure appropriate capital availability for agriculture. These actions have generally involved supporting lending agencies and reducing the cost of credit for needy farmers. Although such credit arrangements have

kept many marginal farmers operating who would otherwise have left farming, abundant credit facilities have contributed to the expansion of farm size through their impact on asset prices and the adoption of new technologies that often require large and lumpy financial commitments (Diagne *et al*. 2000). As larger farms tend to use their equity base in financing non-real estate, the adoption rate and relative competitive position of large farms is enhanced.

Publicly funded research and extension activities have been used by governments to increase the productivity of all farmers but particularly the small to mid-size operation without the financial and management ability to access private information sources. Tweeten (1984) argues that publicly funded research tends to focus on biological developments that are scale neutral, whereas private sector research has emphasised mechanical and chemical technologies that are scale biased. Although increased overall productivity can lead to small profit margins and larger farms, public research and extension activities generally favour smaller farmers.

Land reform policies throughout the developing world have directly altered farm size distribution and favoured smaller farms (Binswanger and Elgin 1998). Transferring land from large owners to peasants has been a popular government policy tool to increase the income of the poor. In addition to its use for equity reasons, the policy of land redistribution and facilitating smaller farms has been supported by some due to the observed inverse relationship between farm size and productivity in developing countries (Berry and Cline 1979).

3. Empirical specification and variables

The three general drivers of farm size outlined in the previous section were based largely on published work for agriculture in developed countries, where the average farm size has increased. In this section, variables for these factors are defined within the context of the Sri Lankan tea sector. The hypothesised effects of the variables are presented along with the definitions of the measures that approximate the variables. The definitions of the variables and their summary statistics are listed in Table 2.

3.1 Dependent variable (Share)

The change in farm size is measured by the share of total area planted to green leaf tea by small holders. Given the 7-year gestation period for tea bushes, the share of area planted represents a better long-term response variable of the reactions of peasants and plantations to exogenous factors than tea output. A registry is maintained by the Sri Lankan Tea Control Department on an annual basis of all plantations or estates, which are legally defined as any tea farm larger than 10 acres in size, and small holders, which are tea farms less than 10 acres in size (see Table 1). The average share of total area planted by small holders is about 26 per cent over the 44-year period (Table 2) but the share has risen from 14 per cent in 1960 to 46 per cent in 2003.

Table 2 Variable definitions and data sources

Variable	Definition	Mean (SD)	Expected effect	Source
Dependent				
Share	Acreage under < 10 acres farms/ Total acreage of green leaf tea	0.26 (0.11)		Annual Bulletin of Statistics, International Tea Committee, various issues
Independent				
Price Effects†				
Wage Ratio	Wages in industry and commerce/ Wage in plantation sector	1.05 (0.33)	–	Annual Reports of Central Bank of Sri Lanka various issues
Alt Returns	Average FOB prices (export value/ export volume) of 6 alternative crops/ Colombo auction black tea price	2.82 (1.25)	–	Annual Reports of Central Bank of Sri Lanka various issues
Price Var	Percentage deviation of Colombo auction black tea prices from its 5-year moving average	20.33 (23.14)	+	Annual Report of Central Bank of Sri Lanka 2000 and 2004
Government Programs				
Price Regulation	= 1 for years 1968–1984 with minimum green leaf price		+	
Price Formula	= 1 for the years 1985–1998 with Reasonable Price Formula		+	
Export Tax	Summation of fixed export tax, *ad-valorem* tax and export Cess/Total tea exports	1.51 (1.64)	–	For 1960–1997 from various sources including IBRD 1970, Central Bank of Sri Lanka, 1970. For 1980–2003 from Plantation Sector Statistical Pocket Book.
Support	Value of small tea farm subsidies	93.29 (41.10)	+	From 1960 to 1979.‡ For 1980–2003 from Plantation Sector Statistical Pocket Book.
Land Reform	= 1 for years 1976–1992		+	

Notes: † All prices, taxes, subsidies and labour wages are deflated with Colombo Consumer Price Index (all items 1952 = 100).
Source: ‡ 1960, 1961 actual and 1962, 1963, 1964 proposed expenditure on small tea farm subsidies from *The Short Term Implementation Program* (1962); for 1965, 1966 proposed expenditure from *Ceylon National Development Plan* (1968); for 1967, 1968 actual expenditure *Ceylon Yearbooks* (1969 and 1970); for 1969, 1970 proposed expenditure *Ceylon Yearbook* (1969); for 1971–1979 estimated at 15 per cent of total levy collected from black tea exports.

Table 3 Labour days required per acre for green leaf production by large and small tea farms

Activity	Large farms (%) 1954	Large farms (%) 1993	Small farms (%) 1982
Harvesting (green leaf)	128 (53)	155 (62)	139 (54)
Weeding	54 (22)	45 (19)	72 (28)
Fertiliser application/forking	12 (5)	14 (6)	6 (2)
Pruning	5.5 (2)	6 (3)	5 (2)
Pest and disease control	19 (8)	8 (3)	–
Lopping shades	–	–	4 (1)
Green leaf transport	–	–	12 (5)
Others	25 (10)	15 (7)	20 (8)
Total	243 (100)	243 (100)	258 (100)

Sources: for large farms in 1954, Lamb (1954), p. 193 (table 1); for large farms in 1993, Liyanage (1993), p. 82 (table 4.1); for small farms in 1982, Fernando (1982), p. 7 (table 5).

3.2 Independent variables

3.2.1 Technology

The economies-of-size model suggests that increases in farm size are the natural consequence of technological advances that lower long-run average costs. However, the production of green leaf tea remains a labour-intensive process with no significant mechanical technologies having been developed over the last century (De Silva 1982; Mendis 1992). There have been biological developments such as vegetatively propagated tea but the technology is arguably scale-neutral and the adoption rate has been low. Labour continues to represent approximately three quarters of the cost of growing and harvesting green leaf tea and labour use has remained relatively constant at 1 labour year per acre on both small and large tea farms (Table 3). The lack of labour-saving technologies evident in other agricultural sectors has not given a comparative advantage to large tea farms. Thus, no explanatory variable for technology was defined to explain the changes in relative viability of farm types.

3.2.2 Price effects

Relative input costs (Wage Ratio). The high price of labour relative to capital has been found to be a major driver of increases in average farm size in developed country agriculture (Kislev and Peterson 1996). In Sri Lankan tea production, the concern is not with the relative prices for capital and labour as there was no substitution between these inputs but with the cost of labour facing different types of farms. The influence of labour expenses on the relative viability of peasants vs. plantations is proxied by the ratio of the opportunity cost of labour for each group. Labour cost for an owner-operator of a small farm depends on forgone earnings and is represented by the industrial worker's daily wage rate, which represents an upper bound on the opportunity cost of family labour. The wage rate facing large tea growers is the plantation sector daily (real) wage rate, which is determined through tripartite agreements between

the unions, government labour officials, and executives of large tea farms. In Sri Lanka, the majority of plantation workers have organised into ethnically based trade unions and political parties whose influence within parliament has increased due to constitutional changes in 1978 (Wilson 1979). The increasing influence of the union-based party in the tripartite wage negotiations has increased union member wages over time. The average value of the ratio between industrial sector wages and plantation sector wages is 1.3 but it has dropped from a high of 1.55 in 1971 to a low of 0.65 in 1993. Declining relative labour wages for small farms is hypothesised to expand their share of production.

Relative output prices (Alt Returns). Tea farms will respond positively to relative output prices, but previous studies have not conclusively determined the effects by farm size. Both small and large tea farms bear significant sunk costs when tea bushes are established as it takes 7 years before a new tea plant generates income (Sivapalan *et al*. 1986). However, the existence of a residential labour force and a hierarchy of supervisory and technical personnel on plantations imply that plantations incur a substantial sunk cost in the provision of associated infrastructure and overhead services (Hayami 2002). Thus, plantations would not cover the sizeable sunk costs if it shut down tea production and switched to other cropping activities unless these other crops were very profitable. The same is true for decisions to expand tea production as evidenced by Akiyama and Trivedi (1987) who found that small farmers responded to relative price increases by more entry and expansion of production area, whereas large tea farms improved yields through adoption of new practices and not by expanding production area. Thus, small farms are hypothesised to be relatively more flexible to respond to economic incentives associated with relative returns to alternative crops.

Six non-traditional, perennial, export crops (pepper, cinnamon, cloves, nutmeg, cardamom and cocoa) were selected as the alternative cropping enterprises. These crops have been proposed as alternatives for unprofitable tea growers. The profitability of these crops was captured by their Free On Board (FOB) prices, which assumes no appreciable differences in their cost of production. The average real FOB price for these six crops is divided by the Colombo auction black tea price to proxy the relative profitability of alternative enterprises. The relative level of returns generally increased for the alternative crops until the 1980s but has gradually fallen since. As small farms are hypothesised to be relatively more flexible to respond to returns from alternative crops, an inverse relationship is expected between these returns and the share of production from small farms.

Output price variability (Price Var). The effects of price instability on production decisions depend on farmers' risk preferences and are particularly important in developing world agriculture as risk markets are typically incomplete (Combes and Guillaumont 2002). Short-term price volatility is measured as the absolute deviation (in percentage terms) of the black tea price in Colombo auction from its 5-year moving average (Athukorala and Huynh 1987). Expected price is the actual price in year $t-2$ to reflect the

delay between planting decisions and actual output produced. There are no perceptible trends in the percentage deviations from the price trend but the largest and smallest values occurred in the 1970s. Large farmers may be less risk averse and better equipped to face short-term liquidation crises but small farmers may be more adaptable to price fluctuations given their reliance on non-farm income opportunities. Thus, direction of association between the small-farm share and price volatility index is uncertain.

3.2.3 Government programs

Output price support (Price Regulation and Price Formula). The Sri Lankan government had no formal income support program until 1968 when it regulated the price for green leaf tea paid by tea processors to green leaf producers. The regulated price for green leaf tea is hypothesised to benefit primarily peasants because of the potential for black tea processors to force down the price paid to small, green leaf farmers without a price support (De Silva 1982; Fernando 1982). The advantageous bargaining position for processors arises for three reasons. First, a small farmer's ability to find an alternative processor is severely constrained by the perishability of green leaf (temporal specificity) and additional costs in transportation (Sri Lankan Ministry of Plantation Industries 1994). Moreover, large switching costs of converting a green leaf tea garden to other uses discourages investment in green leaf production unless *ex-ante* terms on prices are agreed upon by the parties. Second, in the 1960s and 1970s there were no black tea processors who outsourced their entire green leaf requirement so processors were not dependent on the small farms' green leaf production to the extent that smaller farms were dependent on processors. Third, there were no small-scale cottage-based processing technologies for black tea production that smaller farmers could use. Given the strong bargaining position for processors, green leaf price regulation likely reduced the potential for hold-up threats and improved the opportunities for small farms to secure adequate profits.

The regulated green leaf price program is proxied by two dummy variables to differentiate the three time periods with different levels of price control. From 1960 to 1968, green leaf prices were determined through individual negotiations meaning low green leaf prices for growers given the threat of hold up by processors. The first dummy variable (*Price Regulation*) represents the period from 1969 to 1984 when green leaf prices were regulated for the first time and minimum prices were established. The second dummy variable (*Price Formula*) represents the time period since 1985 when the Reasonable Price Formula was implemented. Rather than a minimum price, the formula set the share of the black tea price going to green leaf farmers and significantly increased the price received by all growers.[1]

[1] According to the formula, 25 per cent of the auction price for black tea went to the processor and 75 per cent to the green leaf producer. The share to farmers dropped to 70 per cent in 1985 and then to 68 per cent in 1987.

Export taxes on black tea (Export Tax). The Sri Lankan government has imposed varying levels of taxes on the exports of black tea. The effect of these export taxes on growers of different size depends on their relative demand and supply elasticities. The derived demand for bulk black tea by secondary processors (blenders and packers, who convert bulk black tea in to final consumable product) is likely to be elastic (Ganewatta *et al*. 2005). These processors tend to be dominated by a few multinational corporations that have purchasing agents at the auctions in each of the major black tea producing countries. Weerahewa and Goddard (1997) found UK importers view Sri Lankan, Indian, and Chinese tea as substitutes, which implies an export tax on black tea will prompt secondary processors to switch among their suppliers (Majumdar 1973). Given the gestation period between planted tea bushes to first commercial harvest, tea production tends to be price-inelastic in the short run with estimates in the range of 0.04–0.26 (Ramanujam 1986; Akiyama and Trivedi 1987; Weerahewa *et al*. 1997).

The combination of an elastic derived demand and an inelastic supply response implies that green leaf farmers will bear a large burden of an export tax on tea. Even though the short-run adjustments in supply are price inelastic for both small and large farms, it has been argued earlier that small farms are likely to have greater flexibility in adjusting production. Large farms require a larger amount of skilled, permanent labour and a larger capital asset-base associated with the housing, medical, educational, and other social requirements of this labour (Hayami 2002). Thus, it is hypothesised that the larger the export duties on tea *ceteris paribus*, the smaller will be the share of total tea area grown by small farmers.

Taxes on tea exports include fixed export taxes, *ad-valorem* taxes, and a Cess levy on tea exports to finance subsidies, research, and marketing efforts of the Sri Lanka Tea Board. Since 1992, export taxes and *ad-valorem* taxes have been abolished and only the Cess levy continues. The summation of these three different taxes represents total export taxes on tea. The tax per kilo of tea exports was calculated by dividing this total tax by total tea exports. The real export tax rate (1952 Rs/kg) averaged 1.507 with a low of 0.099 in 1967 and a high of 7.822 in 1978.

Small tea farm support services (Small Support). In an effort to counteract the pecuniary and technological economies of size enjoyed by large farms, governments have provided credit and extension services primarily geared toward small farms for equity reasons. In Sri Lanka, the state has provided services such as credit, subsidised inputs (fertiliser), replanting tea bush programs, and land rehabilitation assistance specifically for small farms (Fernando 1982; Barlow and Jayasuriya 1986). It is hypothesised that the value of support services to small farms would increase the relative share of small farms in the Sri Lankan tea sector. State support to small tea farms is measured as total subsidies allocated to small tea farms divided by tea acreage planted on farms of less than 10 acres. The level of support for small farms has varied significantly

over time. The average support per hectare is 100 rupees but it has ranged from recent levels of around 40 to a high of 191 rupees per hectare in 1986.

Land reform polices (Land Reform). It is hypothesised that the land reform policy increased the relative share of small tea farms. The Sri Lankan Land Reform Commission acquired a total of 981 357 acres or about 23 per cent of the total land area under permanent agriculture in the country through land reform legislation passed in 1972 and 1975. However, only 11 per cent (109 000 acres) of the total land acquired was distributed among peasants and it is unknown the extent to which this land ended up as small tea farms (Peiris 1984).

Although the actual redistribution of land may have had a relatively small positive effect on the production share of small farmers, a potentially bigger indirect effect may have been felt through the management of acquired land by public sector agencies during the post-land-reform period. Approximately 70 per cent or 680 000 acres of the total acquired land area allocated to public agencies went to two state corporations: State Plantation Corporation and Janatha Estate Development Board (Peiris 1984) until the re-privatisation in 1992. Between 1978 and 1992, tea production by these two corporations declined by about 19 per cent, whereas their real cost of production doubled resulting in 5 years with negative profit margins. As a consequence, 52 large tea farms under state-owned management were identified as economically non-viable. The poor management performance by the state led to the privatization of management services on all state-owned plantations in 1992 (World Bank 1997). The direct and indirect effects of the land reform legislation are captured by a dummy variable for the years in which the policy was in effect (*Land Reform* = 1 for years 1976 to 1992 and 0 otherwise).

3.3 Econometric model

The empirical model relating the share of total tea area grown by peasants to the five explanatory variables defined in the previous section is estimated through the following Box–Cox transformation used to avoid functional form misspecification in estimation:

$$\begin{aligned} Share^{(\lambda)} = {} & \beta_0 + \beta_1\, Wage\ Ratio^{(\lambda)} + \beta_2\, Alt\ Returns^{(\lambda)} + \beta_3\, Price\ Var^{(\lambda)} \\ & + \beta_4\, Price\ Regulation + \beta_5\, Price\ Formula + \beta_6\, Export \\ & + Tax^{(\lambda)} + \beta_7\, Support^{(\lambda)} + \beta_8\, Land\ Reform + U \end{aligned} \tag{1}$$

where U is a random error term assumed to be normally distributed with zero mean and a constant variance.[2] The first step of the procedure is to find

[2] The stationarity of the variables was tested with Augmented Dicky–Fuller test and all the five variables (excluding dummies) were found to be nonstationary with unit roots. Engle–Granger tests for the residuals of the regression were found to be stationary indicating the variables behave in a long-term equilibrium association.

Table 4 Maximum likelihood estimates of regression explaining the share of small farms in the Sri Lankan tea area (from 1960 to 2003)

Variable	Estimated coefficient	Asymptotic T-ratio
Intercept	–1.565	–
Price Effects		
Wage Ratio	–0.8797***	–29.064
Alt Returns	0. 1947***	7.460
Price Var.	–0.0305*	3.731
Government Programs		
Price Regulation	0.201***	9.472
Price Formula	0.249**	4.099
Export Tax	–0.1815***	–26.0
Support	0.3498*	3.785
Land Reform	0.0703	0.999

Notes: Log of Likelihood Function = 127.154; Likelihood Ratio Test of the model (chi-squared) = 164.79***; Box–Cox Parameter (λ) = –0.35344; Durbin–Watson statistic = 1.939; Mackinnon approximate *P*-value for Augmented Dicky–Fuller Test for residuals = 0.0075; * and ** denote statistical significance at 5 and 1 per cent levels, respectively.

an estimate of the Box–Cox parameter (λ) that maximises the log-likelihood function. The estimated λ is then used as a 'known' fixed value to obtain maximum likelihood estimators of the βs and σ^2. Each variable is divided by its geometric mean. The re-scaling leaves the parameter λ unaffected but the β coefficients are now point elasticities. In addition, the re-scaling results in valid standard errors compared to the underestimated conditional standard errors with the original data (Spitzer 1984). An asymptotic likelihood ratio test is used to test whether the functional form is linear ($\lambda = 1$) or logarithmic ($\lambda = 0$) or multiplicative inverse ($\lambda = -1$).

4. Results

The maximum likelihood estimates of the Box–Cox regression are given in Table 4. Linear, inverse multiplicative, and natural log specifications are all rejected as valid specifications according to the chi-squared values of the likelihood ratio test. The estimated model explains the variability in the small-farm share of tea acreage satisfactorily as the model's log likelihood ratio test is significant at the 1 per cent level. In addition, six of the eight estimated coefficients are statistically significant and these all have signs consistent with the theoretical propositions except *Alt Return.*

The estimated coefficient for the ratio of opportunity cost of labour for peasants and plantations (*Wage Ratio*) has the expected negative effect and is highly significant. Since the 1980s, the relative opportunity cost of labour for small tea farms has decreased rapidly and the result has been an increase in the share of green leaf from the relatively less-expensive production. Wages on large tea farms may not be based on labour productivity (World Bank 1997).

Government intervention in determining plantation sector labour wages and other terms of employment prevent management from extracting higher productivity from labour (Report of Presidential Commission on the Tea Industry and Trade 1995). This Report noted that any further increases in wage-related costs without a substantial increase in productivity were the 'surest way of killing the tea (plantation) industry' (p. 150) and the empirical evidence here supports that claim.

It was hypothesised that an increase in the returns from alternative crops relative to tea (*Alt Returns*) would decrease the share of tea production from small farms as it was assumed that *ceteris paribus* small tea farms have more flexibility to switch to other enterprises. Contrary to the prior expectation, the estimated coefficient is positive and statistically significant. The result suggests that small holders may respond to a price decrease by maintaining their tea bushes, but stop plucking tea rather than shift production to other crops. Supply response may have been higher for smaller producers if data were available to estimate the model at a regional level. The mid-elevation region expanded production in alternative crops to a greater extent than smallholders in the low-elevation area due to differences in spatial comparative advantage.

The negative and significant relationship between the price instability index (*Price Var*) and the share of small farms suggests small farmers may be relatively more risk averse and tend to decrease relative production when tea price risk increases. Large farms may be able to handle price instability through access to bank overdraft facilities in banks and holding financial reserves, whereas small farms may handle the risk by decreasing planted area directly through diversion to less risky crops and/or by spending more time in off-farm employment.

Government programs seem to have greater explanatory powers in explaining the changes in the relative viability of plantations versus peasants in tea production than the previous three variables capturing price effects. All the coefficients of the variables that capture the government programs have the expected signs and are highly significant with the exception of the *Land Reform* variable.

Government regulation of the green leaf tea price was hypothesised to reduce the hold-up problem facing small tea growers and thus increase their share of total production. The positive coefficients for both time periods of government price intervention support the hypothesis. The effect is particularly significant for the initial period of *Price Regulation* from 1969 to 1984. Thus, intervention by the government has insured the price received by all independent growers of green leaf tea and allowed farmers to confidently assess the relative profitability of planting tea bushes. The price assurance was particularly important to small growers who were most vulnerable to the threat of hold up by processors.

Commodity export taxes are detrimental to all primary producers as they depress farm-level prices, but it was hypothesised that the relative share of

small tea farms in Sri Lanka would decrease with higher tea export taxes as their supply response is more elastic. Many have argued against the exorbitant level of the tea export tax (Bhalla 1991) but the impact of those taxes on plantation versus peasant producers has not been previously examined. The estimated negative relationship indicates that the increases in export taxes have discouraged the entry of small holders into tea production more than it has for large farms.

The positive association between the value of small-farm support services and the share of small tea farms is as expected. This direct correlation between the level of support provided to small farmers by the state and the consequent expansion in the small-farm sector relative to large farms has been noted for many other developing countries (Barlow and Jayasuriya 1986).

Land reform policies have not been effective in increasing the share of small tea farms. A direct insignificant effect was expected as land redistribution for the small farmers was not the primary objective of land reform policies in Sri Lanka. In countries like Papua New Guinea, plantations owned by multinational corporations were acquired by the government and land ownership transferred directly to small holders. Similar distributional effects resulted from land reform activities in India, China, Japan, Taiwan, and the Philippines. Although claims have been made about the effectiveness of Sri Lankan land reform in expanding peasant involvement (i.e., Fernando 1982), the insignificant coefficient is consistent with the view that tea plantations acquired by the government were kept largely in state hands with a small portion given to small farmers. The result also counters claims that the share of small tea farms would rise indirectly due to the inefficiency of the state-run plantations resulting from the land reform policies.

5. Conclusions

The increasing role of peasants in the Sri Lankan tea sector and the decline of the plantation can be explained by the same factors empirically found to drive the increase in farm size within developed countries: government programs and prices. Government programs have had a significant direct and indirect effect on the shift in the total tea area of Sri Lanka from large plantation farms to small, household farms. Support services specifically targeted toward small farmers have offset the pecuniary economies and information access enjoyed by larger producers. The largest effects of government policy have been felt indirectly through prices. The establishment of a pricing formula for green leaf tea reduced the hold-up problems confronting small tea growers selling to processors. The perishability of the product and the significant sunk costs incurred in establishing a tea garden gave processors bargaining power over growers in the determination of the green leaf price. A regulated price reduced this bargaining power and provided small farmers some certainty over the returns from tea production.

The other major price effect influencing average farm size in Sri Lankan tea production has been relative wage costs that are indirectly influenced by government. Small growers face an opportunity cost of labour equal to the industrial wage rate. This rate has declined over time in comparison to the wages paid to unionised employees on large tea plantations that are established through political negotiations. Labour costs remain the dominant expense in growing green leaf tea so small growers have become the low-cost mode of production.

Government programs and price effects that reduced revenue uncertainty and relative costs of production have allowed small farmers to significantly increase their share of total tea production in Sri Lanka. Thus, farm size can decrease under the influence of the same general drivers that have explained the increase in farm size elsewhere. However, a major driver of increasing farm size in developed countries has been the introduction of labour-saving technology. Mechanical technologies have not been developed for the harvesting of tea leaves so that labour remains the major input on both peasant farms and plantations. The introduction of such technology may shift the trend in the comparative advantage of small holders back to large estates.

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